GROWING KNOWLEDGE

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The sudden oak death epidemic in Oregon

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OREGON NURSERIES are increasingly threatened by the repeated expansion of the sudden oak death (SOD) epidemic in Curry County. Although this epidemic is geographically far away from the main nursery production areas, the continued expansion of the SOD quarantine area and the newly discovered introduced EU1 clone are distinct threats to the nursery industry.

What is sudden oak death?

Sudden oak death (SOD) is a devastating disease that kills oaks and other species of trees. The disease is caused by a plant pathogen, the fungal-like organism *Phytophthora ramorum*.

SOD was first discovered in the mid-1990s in California's coastal forests. In 2001, SOD was detected in coastal Curry County in southwest Oregon tanoak forests. Since then, Oregon has focused on limiting the spread of the disease in Curry County through early detection, monitoring and eradication of symptomatic tanoak trees.

Despite these efforts, the quarantine area in Curry County has expanded seven times since 2001, from nine square miles to 515 square miles. The rate of disease spread increased most dramatically in 2014, requiring the quarantine area to nearly double in 2015. Over 135 plants, many of which are native to Oregon or common to Oregon's nursery trade, can be hosts to *P. ramorum*.

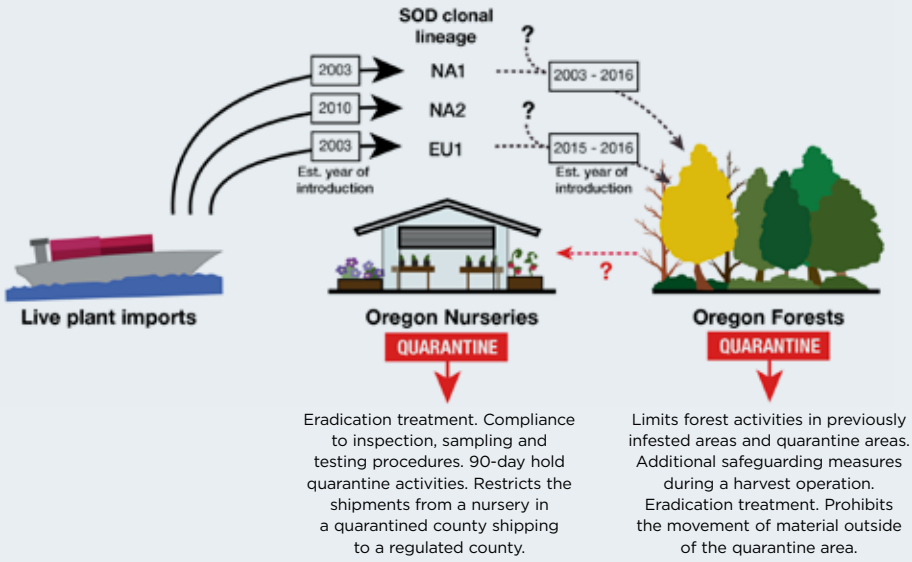

Figure 1. This infographic depicts the movement of SOD along different pathways and potential implications for nursery and forest production. A pathway of pathogen movement from the forest back to nurseries has not yet been documented for Oregon, but this is a new high-risk pathway as SOD becomes more entrenched in Oregon forests (red pathway).

How did it arrive in Oregon?

Scientists have documented five intercontinental migrations of *P. ramorum* and three distinct introductions to the West Coast. Currently, we distinguish four clonal lineages: NA1, NA2, EU1 and EU2.

The North American clone, NA1, was the first clone to arrive in the U.S. via plant imports of exotic ornamentals into nurseries. NA1 is responsible for SOD outbreaks in California and southwest Oregon forests.

A second introduction, of the genetically distinct clone NA2, occurred into British Columbia and Washington nurseries. A third introduction, of the European clone EU1, likely arrived from Europe into Pacific Northwest nurseries. The origin of these clones is still a mystery, but they most likely arrived in the U.S. with live plant imports.

It is clear that there is a direct link between forest and nursery production systems: the pathogen was initially introduced into nurseries and then subsequently moved into forests (Figure 1).

What do we know about nurseries?

Since it was discovered in an Oregon nursery in 2003, SOD has been detected in Oregon nursery sites every year. To date, three of the four clones — NA1, NA2 and EU1 — have been found in Oregon nurseries. The 2003 detection included both the NA1 and EU1 clones. Since then, the EU1 clonal lineage has shown persistence in Oregon nurseries and has become the dominant clone.

The third clone, NA2, was detected in 2012 much later than the other two clones. Oregon nurseries exporting out of state are subject to yearly inspections for the presence of *P. ramorum* on hosts such as *Rhododendron*, *Pieris*, *Viburnum*, *Kalmia* and *Camellia*.

If SOD becomes more widely distributed, the likelihood of infection in nurseries will increase substantially.

SOD epidemic in Curry County

To date, we have documented three separate introductions of the pathogen into Curry County forests. Studies of the genetic diversity of the pathogen indicate that the NA1 clone was introduced twice into Curry County forests. In 2015, a third introduction of *P. ramorum* occurred (Figure 2). This latest introduction is the EU1 clone.

For at least the past two years, the two clonal lineages NA1 and EU1 have coexisted in southwest Oregon. Despite quarantine regulations, *P. ramorum* continues to be introduced, suggesting that current regulatory efforts may not be enough to curb the spread of SOD.

Once introduced in Oregon, infections can be hard to control due to the presence of ubiquitous hosts, favorable environmental conditions, the pathogen life cycle and lack of funding for disease management. Oregon's wet climate promotes easy dispersal of the pathogen from hosts via rainy weather events. Natural spread of spores can be up to 3–4 miles each year.

Long-distance transport occurs via the movement of infected nursery stock or infested soil. Once transported, *P. ramorum* is capable of long-term survival in plant material and soil, further complicating disease control.

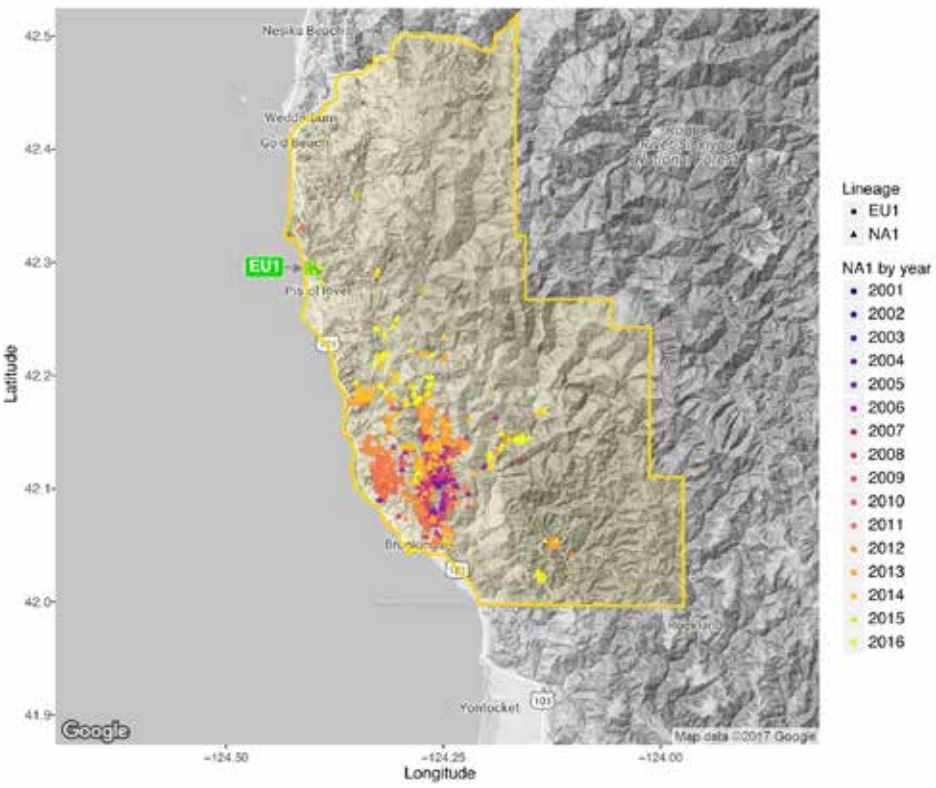

Figure 2. SOD was first detected in 2001, north of Brookings, Oregon, in the area with dark blue/purple spots and subsequently spread east, north and northwest. Until 2014, only the NA1 clonal lineage (triangles) was found in Curry County, Oregon. The EU1 clone (green circles) shows up for the first time in 2015 and was confirmed again in 2016. The area outlined in yellow is the current quarantine zone.

Emergence of EU1

The emergence of the EU1 clonal lineage in Curry County prompted the formation of the Task Force on Sudden Oak Death. Stakeholders, including state and federal agencies, local tribes and industry associations, are working to identify ways to prevent the spread of SOD and mitigate the potential negative economic and environmental impacts.

The EU1 and NA1 clones are of opposite sex. Thus, the possibility exists that sexual populations could establish. Sexual reproduction can increase the risk of a pathogen being more aggressive by allowing faster adaptation to crops and fungicides.

Why is SOD in Curry County a risk to growers statewide?

P. ramorum can potentially spread anywhere in Oregon where tanoak or other susceptible hosts, such as Oregon myrtlewood or rhododendron, are located.

The spread of *P. ramorum* through forests could put Oregon nurseries at risk. It has been shown that introductions from nurseries to forests, and nurseries to nurseries, can occur. These occurrences suggest that introductions from forests to nurseries are also possible, although such an occurrence has yet to be documented in Oregon.

What are the consequences for Oregon's forests?

The strategy addressing the spread of SOD in Oregon has transitioned from one of eradication to one of slowing the disease's spread. Despite faster spread in recent years, the disease is still limited to Curry County where forest activities, such

as timber harvest and the collection of special forest products, have been affected in previously infested SOD areas and areas within the quarantine.

Additional required safeguarding measures during harvest operations, such as log washing and making sure soil and plant debris stay on site, have had a large impact on timber harvest. If SOD spreads outside of the current quarantine boundaries, the next quarantine expansion would encompass all of Curry County.

The implications of a larger SOD quarantine would further elevate economic losses and could reduce market access and sales for Oregon growers. Impediments to the export of logs and lily bulbs from Curry County have recently been encountered. This risk to domestic and international trade could extend to other forest and agricultural commodities if the quarantine boundary increased.

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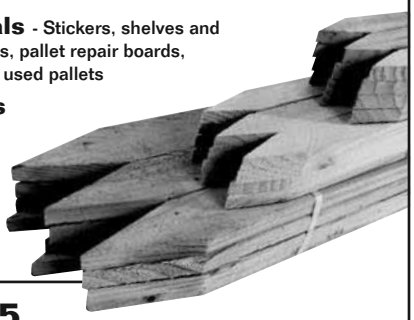

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